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## **Chapter 7: General Principles of Exercise Prescription**

American College of Sports Medicine. (2010). ACSM's Guidelines for exercise testing and prescription (8th ed.). New York: Lippincott, Williams and Wilkins



# General Principles of Exercise Prescription

- Designed to meet individual health and physical fitness goals
- Based on application of scientific evidence
- Intended as guidelines for apparently healthy adults
- Components to be addressed include:
  - cardiovascular (aerobic) fitness,
  - muscular strength and endurance,
  - flexibility,
  - body composition,
  - neuromuscular fitness (balance, agility), and
  - bone health.



- When determining exercise programming, consider:
  - individual's goals,
  - physical ability,
  - health status, and
  - available equipment.

## BOX 7.1

## Components of the Exercise Training Session

- Warm-up: At least 5 to 10 minutes of low- ( $<40\% \dot{V}O_2R$ ) to moderate- ( $40\% - <60\% \dot{V}O_2R$ ) intensity cardiovascular and muscular endurance activities
- Conditioning: 20 to 60 minutes of aerobic, resistance, neuromuscular, and/or sport activities (exercise bouts of 10 minutes are acceptable if the individual accumulates at least  $20$  to  $60 \text{ min} \cdot \text{d}^{-1}$  of daily exercise)
- Cool-down: At least 5 to 10 minutes of low- ( $<40\% \dot{V}O_2R$ ) to moderate- ( $40\% - <60\% \dot{V}O_2R$ ) intensity cardiovascular and muscular endurance activities
- Stretching: At least 10 minutes of stretching exercises performed after the warm-up or cool-down phase

Note: These recommendations are consistent with the United States Department of Health & Human Services Physical Activity Guidelines for Americans, available at <http://www.health.gov/PAGuidelines/pdf/paguide.pdf> (October 7, 2008).



# Conditioning Phase

- FITT principle
  - F = Frequency
  - I = Intensity
  - T = Time (duration)
  - T = Type (mode)



## Frequency: How Much Is Enough?

- Function of frequency, intensity, and duration
- Dose-response relationship
- Minimum/maximum necessary related to health/fitness goals
- Any/some exercise preferable to physical inactivity

## TABLE 7.1. GENERAL EXERCISE RECOMMENDATIONS FOR HEALTHY ADULTS

WEEKLY FREQUENCY  
( $d \cdot wk^{-1}$  devoted to an  
exercise program)

DO THESE TYPES OF EXERCISES

At least 5  $d \cdot wk^{-1}$

Moderate intensity (40% to  $<60\% \dot{V}O_2R$ ) aerobic (cardiovascular endurance) activities, weight-bearing exercise, flexibility exercise

At least 3  $d \cdot wk^{-1}$

Vigorous intensity ( $\geq 60\% \dot{V}O_2R$ ) aerobic activities, weight-bearing exercise, flexibility exercise

3–5  $d \cdot wk^{-1}$

A combination of moderate- and vigorous-intensity aerobic activities, weight-bearing exercise, flexibility exercise

2–3  $d \cdot wk^{-1}$

Muscular strength and endurance, resistance exercise, calisthenics, balance and agility exercise



## Frequency: Summary

- Moderate-intensity aerobic exercise done at least 5 d·wk<sup>-1</sup>, vigorous-intensity aerobic exercise done at least 3 d·wk<sup>-1</sup>, or a weekly combination of 3 to 5 d·wk<sup>-1</sup> of moderate- and vigorous-intensity exercise is recommended for the majority of adults to achieve and maintain health/fitness benefits.



# Intensity

- An increasing intensity yields a positive continuum of health/fitness benefits.
- Moderate intensity (an intensity that noticeably increases HR and breathing) is recommended as minimum to achieve health/fitness benefits.
- A combination of moderate and vigorous intensity (an intensity results in substantial increases in HR and breathing) is ideal to achieve health/fitness benefits in most adults.

# Methods to Quantify Exercise Intensity

- HR reserve (HRR)
- $VO_2$  reserve ( $VO_2R$ )
- Ratings of perceived exertion (RPE)
- OMNI
- Talk test
- Affective valence
- Absolute energy expenditure per minute ( $\text{kcal}\cdot\text{min}^{-1}$ )
- % age-predicted  $HR_{\text{max}}$
- % oxygen uptake ( $\%VO_2$ )
- Metabolic equivalents (METs)

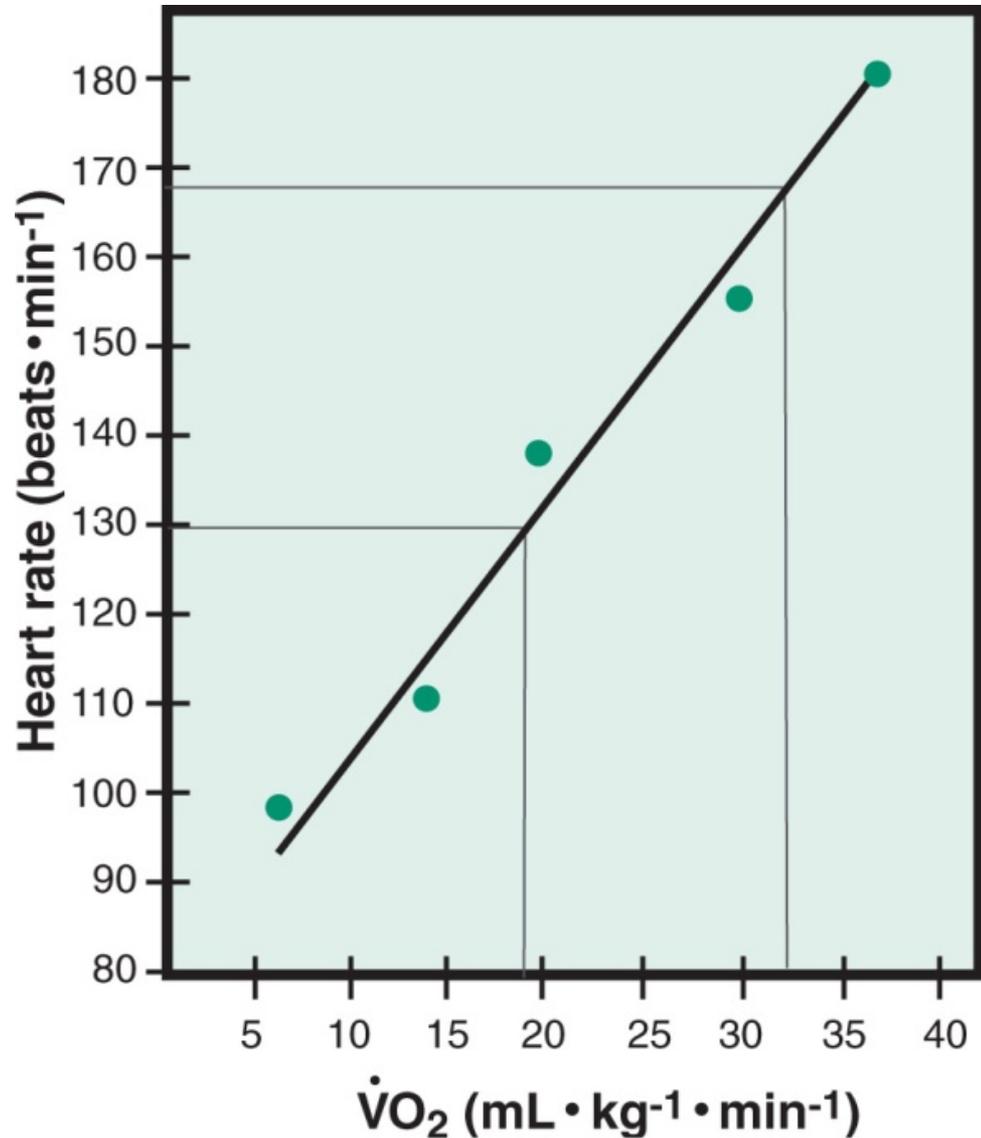
# Intensity: Relationship Between Heart Rate and $\dot{V}O_2$



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Prescribing exercise heart rate using the relationship between heart rate and  $\dot{V}O_2$ . A line of best fit has been drawn through the data points on this plot of HR and  $\dot{V}O_2$  during a hypothetical exercise test in which  $\dot{V}O_{2max}$  was observed to be  $38 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$  and  $\text{HR}_{max}$  was  $184 \text{ beats} \cdot \text{min}^{-1}$ . A target HR range was determined by finding the HR that corresponds to 50% and 85%  $\dot{V}O_{2max}$ . For this individual, 50%  $\dot{V}O_{2max}$  was  $\sim 19 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ , and 85%  $\dot{V}O_{2max}$  was  $\sim 32 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ . The corresponding THR range is 130 to 168  $\text{beats} \cdot \text{min}^{-1}$ .



**BOX 7.2****Summary of Methods for Prescribing Exercise Intensity Using Heart Rate (HR), Oxygen Uptake ( $\dot{V}O_2$ ), and Metabolic Equivalents (METs)**

- HR reserve (HRR) method: Target HR (THR) =  $[(HR_{\max} - HR_{\text{rest}}) \times \% \text{ intensity desired}] + HR_{\text{rest}}$
- $\dot{V}O_2$  reserve ( $\dot{V}O_2R$ ) method: Target  $\dot{V}O_2R^a = [(\dot{V}O_{2\max} - \dot{V}O_{2\text{rest}}) \times \% \text{ intensity desired}] + \dot{V}O_{2\text{rest}}$
- Peak HR method: Target HR =  $HR_{\max}^b \times \% \text{ intensity desired}$
- Peak  $\dot{V}O_2$  method: Target  $\dot{V}O_2^a = \dot{V}O_{2\max}^c \times \% \text{ intensity desired}$
- Peak MET  $\times$  (% MET) method: Target MET<sup>a</sup> =  $[(\dot{V}O_{2\max}^c) / 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}]^c \times \% \text{ intensity desired}$

<sup>a</sup>Activities at the target  $\dot{V}O_2$  and MET can be determined using a compendium of physical activity (8,9) or metabolic calculations (6) (Table 7.2).

<sup>b</sup> $HR_{\max}$  is estimated by  $220 - \text{age}$  or some other prediction equation.

<sup>c</sup> $\dot{V}O_{2\max}$  is estimated by maximal or submaximal exercise testing.

## Prediction of Maximal Heart Rate ( $HR_{max}$ )

- In absence of GXT, prediction of  $HR_{max}$  may be necessary to prescribe intensity of exercise.
- Historically, use of “220 – age” has been used for males and females
  - Underestimates  $HR_{max}$  for both genders <40 years
  - Overestimates  $HR_{max}$  for both genders >40 years
- More accurate predictor:
  - $HR_{max} = 206.9 - (0.67 \times \text{age})$

**TABLE 7.2. METABOLIC CALCULATIONS FOR THE ESTIMATION OF ENERGY EXPENDITURE [ $\dot{V}O_2$  ( $\text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ )] DURING COMMON PHYSICAL ACTIVITIES**

ACTIVITY	SUM THESE COMPONENTS			LIMITATIONS
	RESTING COMPONENT	HORIZONTAL COMPONENT	VERTICAL COMPONENT/ RESISTANCE COMPONENT	
Walking	3.5	$0.1 \times \text{speed}^a$	$1.8 \times \text{speed}^a \times \text{grade}^b$	Most accurate for speeds of 1.9–3.7 mph (50–100 $\text{m} \cdot \text{min}^{-1}$ )
Running	3.5	$0.2 \times \text{speed}^a$	$0.9 \times \text{speed}^a \times \text{grade}^b$	Most accurate for speeds >5 mph (134 $\text{m} \cdot \text{min}^{-1}$ )
Stepping	3.5	$0.2 \times \text{steps per min}$	$1.33 \times (1.8 \times \text{step height}^c \times \text{steps per min})$	Most accurate for stepping rates of 12–30 steps per min

**TABLE 7.2. METABOLIC CALCULATIONS FOR THE ESTIMATION OF ENERGY EXPENDITURE [ $\dot{V}O_2$  ( $\text{mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ )] DURING COMMON PHYSICAL ACTIVITIES**

ACTIVITY	SUM THESE COMPONENTS			LIMITATIONS
	RESTING COMPONENT	HORIZONTAL COMPONENT	VERTICAL COMPONENT/ RESISTANCE COMPONENT	
Leg cycling	3.5	3.5	$(1.8 \times \text{work rate}^d) / \text{body mass}^e$	Most accurate for work rates of 300–1,200 $\text{kg} \cdot \text{m} \cdot \text{min}^{-1}$ (50–200 W)
Arm cycling	3.5		$(3 \times \text{work rate}^d) / \text{body mass}^e$	Most accurate for work rates between 150–750 $\text{kg} \cdot \text{m} \cdot \text{min}^{-1}$ (25–125 W)



# Intensity

- Preferred primary methods
  - HRR
  - $VO_2R$
- Practical primary methods
  - % age-predicted  $HR_{max}$
  - Estimated  $VO_{2max}$
- Other primary measures
  - RPE (may also be adjunct)
  - OMNI (may also be adjunct)
- Adjunct measures
  - Talk test
  - Affective valence



## Intensity: Summary

- A combination of moderate- and vigorous-intensity exercise is recommended for most adults. Exercise intensity may be estimated using HRR,  $VO_2R$ , % age-predicted  $HR_{max}$ , % estimated  $VO_{2max}$ , and perceived exertion.

## Heart Rate Reserve (HRR) Method

Available test data:

$$HR_{\text{rest}}: 70 \text{ beats} \cdot \text{min}^{-1}$$

$$HR_{\text{max}}: 180 \text{ beats} \cdot \text{min}^{-1}$$

Desired exercise intensity range: 50%–60%

Formula: Target Heart Rate (THR) =  $[(HR_{\text{max}} - HR_{\text{rest}}) \times \% \text{ intensity}] + HR_{\text{rest}}$

1) Calculation of HRR:

$$\text{HRR} = (HR_{\text{max}} - HR_{\text{rest}})$$

$$\text{HRR} = (180 \text{ beats} \cdot \text{min}^{-1} - 70 \text{ beats} \cdot \text{min}^{-1}) = 110 \text{ beats} \cdot \text{min}^{-1}$$

2) Determination of exercise intensity as %HRR:

Convert desired %HRR into a decimal by dividing by 100

$$\% \text{HRR} = \text{desired intensity} \times \text{HRR}$$

$$\% \text{HRR} = 0.5 \times 110 \text{ beats} \cdot \text{min}^{-1} = 55 \text{ beats} \cdot \text{min}^{-1}$$

$$\% \text{HRR} = 0.6 \times 110 \text{ beats} \cdot \text{min}^{-1} = 66 \text{ beats} \cdot \text{min}^{-1}$$

3) Determine THR range:

$$\text{THR} = (\% \text{HRR}) + HR_{\text{rest}}$$

To determine lower limit of THR range:

$$\text{THR} = 55 \text{ beats} \cdot \text{min}^{-1} + 70 \text{ beats} \cdot \text{min}^{-1} = 125 \text{ beats} \cdot \text{min}^{-1}$$

To determine upper limit of THR range:

$$\text{THR} = 66 \text{ beats} \cdot \text{min}^{-1} + 70 \text{ beats} \cdot \text{min}^{-1} = 136 \text{ beats} \cdot \text{min}^{-1}$$

THR range: 125 beats  $\cdot$  min<sup>-1</sup> to 136 beats  $\cdot$  min<sup>-1</sup>

*%HR<sub>max</sub> (Measured or Estimated) Method:*

Available data:

A man 45 yr of age

Desired exercise intensity: 70%–80%

Formula:  $\text{THR} = \text{HR}_{\text{max}} \times \text{desired \%}$

Calculate estimated  $\text{HR}_{\text{max}}$  (if measured  $\text{HR}_{\text{max}}$  not available):

$$\text{HR}_{\text{max}} = 220 - \text{age}$$

$$\text{HR}_{\text{max}} = 220 - 45 = 175 \text{ beats} \cdot \text{min}^{-1}$$

1) Determine THR range:

$$\text{THR} = \text{Desired \%} \times \text{HR}_{\text{max}}$$

Convert desired  $\% \text{HR}_{\text{max}}$  into a decimal by dividing by 100

Determine lower limit of THR range:

$$\text{THR} = 175 \text{ beats} \cdot \text{min}^{-1} \times 0.70 = 123 \text{ beats} \cdot \text{min}^{-1}$$

Determine upper limit of THR range:

$$\text{THR} = 175 \text{ beats} \cdot \text{min}^{-1} \times 0.80 = 140 \text{ beats} \cdot \text{min}^{-1}$$

THR range: 123  $\text{beats} \cdot \text{min}^{-1}$  to 140  $\text{beats} \cdot \text{min}^{-1}$

## $\% \dot{V}O_{2max}$ (Measured or Estimated) Method

Available data:

A woman 45 yr of age

Estimated  $\dot{V}O_{2max}$ :  $30 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$

Desired  $\dot{V}O_2$  range: 50%–60%

Formula:  $\dot{V}O_{2max} \times \text{desired } \%$

Determine target  $\dot{V}O_2$  range:

Target  $\dot{V}O_2 = \text{Desired } \% \times \dot{V}O_{2max}$

Convert desired intensity ( $\% \dot{V}O_2$ ) into a decimal by dividing by 100

Determine lower limit of target  $\dot{V}O_{2max}$  range

$$\text{Target } \dot{V}O_2 = 0.50 \times 30 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 15 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

Determine upper limit of target  $\dot{V}O_{2max}$  range:

$$\text{Target } \dot{V}O_2 = 0.60 \times 30 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 18 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

Target  $\dot{V}O_2$  range:  $15 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$  to  $18 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$

1) Determine MET target range (optional):

$$1 \text{ MET} = 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

Calculate lower MET target:

$$1 \text{ MET} / 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} \times \text{MET} / 16.8 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

$$\times \text{MET} = 16.8 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} / 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 4.8 \text{ METs}$$

Calculate upper MET target:

$$1 \text{ MET} / 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = \times \text{MET} / 19.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

$$\times \text{MET} = 19.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} / 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 5.6 \text{ METs}$$

2) Identify physical activities requiring energy expenditure within the target range from compendium of physical activities (9,19) or by using metabolic calculations shown in Table 7.2 and reference (6,7). See examples of use of metabolic equations below.

Using metabolic calculations (6) (Table 7.2) to determine running speed on a treadmill

Available data:

A man 32 yr of age

Weight: 130 lb (59 Kg)

Height: 70 in (177.8 cm)

$\dot{V}O_{2\max}$ : 54 mL · kg<sup>-1</sup> · min<sup>-1</sup>

Desired treadmill grade: 2.5%

Desired exercise intensity: 80%

Formula:  $\dot{V}O_2 = 3.5 + (0.2 \times \text{speed}) + (0.9 \times \text{speed}) \times \% \text{ grade}$

1. Determine target  $\dot{V}O_2$

Target  $\dot{V}O_2 = \text{desired \%} \times \dot{V}O_{2\max}$

Target  $\dot{V}O_2 = 0.80 \times 54 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 43.2 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$

2. Determine treadmill speed:

$\dot{V}O_2 = 3.5 + (0.2 \times \text{speed}) + (0.9 \times \text{speed} \times \% \text{ grade})$

$43.2 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 3.5 + (0.2 \times \text{speed}) + (0.9 \times \text{speed} \times 0.025)$

$39.7 = (0.2 \times \text{speed}) + (0.9 \times \text{speed} \times 0.025)$

$39.7 = (0.2 \times \text{speed}) + (0.0225 \times \text{speed})$

$39.7 = 0.2225 \times \text{speed}$

$175.6 \text{ m} \cdot \text{min}^{-1} = \text{speed}$

Speed on treadmill: 10.5 km · hr<sup>-1</sup> (6.5 mph)

Using metabolic calculations (6) (Table 7.2) to determine % grade during walking on a treadmill

Available data:

A man 54 yr of age who is moderately physically active

Weight: 190 lb (86.4 kg)

Height: 70 in (177.8 cm)

Desired walking speed: 2.5 mph (4 km · hr<sup>-1</sup>; 67 m · min<sup>-1</sup>)

Desired MET: 5 METs

Formula:  $\dot{V}O_2 = 3.5 + (0.1 \times \text{speed}) + (1.8 \times \text{speed} \times \% \text{ grade})$

1. Determine target  $\dot{V}O_2$ :

$$\text{Target } \dot{V}O_2 = \text{MET} \times 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

$$\text{Target } \dot{V}O_2 = 5 \times 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 17.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

2. Determine treadmill grade:

$$\dot{V}O_2 = 3.5 + (0.1 \times \text{speed}) + (1.8 \times \text{speed} \times \% \text{ grade})$$

$$17.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 3.5 + (0.1 \times 67 \text{ m} \cdot \text{sec}^{-1}) +$$

$$(1.8 \times 67 \text{ m} \cdot \text{sec}^{-1} \times \% \text{ grade})$$

$$14 = (0.1 \times 67 \text{ m} \cdot \text{sec}^{-1}) + (1.8 \times 67 \text{ m} \cdot \text{sec}^{-1} \times \% \text{ grade})$$

$$14 = 6.7 + (120.6 \times \% \text{ grade})$$

$$7.3 = 120.6 \times \% \text{ grade}$$

$$0.06 = \% \text{ grade}$$

$$\% \text{ grade} = 6\%$$

Using metabolic calculations (6) (Table 7.2) to determine target work rate ( $\text{kg} \cdot \text{m} \cdot \text{min}^{-1}$ ) on a Monarch leg cycle ergometer

Available data:

A woman 42 yr of age

Weight: 190 lb (86.4 kg)

Height: 70 in (177.8 cm)

Desired  $\dot{V}\text{O}_2$ :  $18 \text{ kg} \cdot \text{m} \cdot \text{min}^{-1}$

Formula:  $\dot{V}\text{O}_2 = 7.0 + (1.8 \times \text{work rate})/\text{body mass}$

1. Calculate work rate on cycle ergometer:

$$\dot{V}\text{O}_2 = 7.0 + (1.8 \times \text{work rate})/\text{body mass}$$

$$18 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = 7.0 + (1.8 \times \text{work rate})/86.4 \text{ kg}$$

$$11 = (1.8 \times \text{work rate})/86.4$$

$$950.4 = 1.8 \times \text{work rate}$$

$$528 = \text{work rate}$$

$$\text{Work rate} = 528 \text{ kg} \cdot \text{m}^1 \cdot \text{min} = 86.6 \text{ W}$$



## Time (Duration)

- Prescribed as a measure of either:
  - amount of time physical activity is performed, or
  - total caloric expenditure.
- May be continuous or intermittent
- Dose-related response between total calories expended per week and health/fitness benefits
  - Recommended minimum is  $1,000 \text{ kcal}\cdot\text{wk}^{-1}$ 
    - $150 \text{ min}\cdot\text{wk}^{-1}$  ( $\sim 30 \text{ min}\cdot\text{d}^{-1}$ )
  - Pedometer steps useful assessment of quantity
    - 3,000 to 4,000 steps per day
  - Maximum safe quantity of exercise not known

## Time (Duration): Summary

- The following is recommended for most adults:
  - *At least 30 min on  $>5 d \cdot wk^{-1}$  at moderate int to total at least  $150 m \cdot wk^{-1}$*
  - *At least 20 min on  $>3 d \cdot wk^{-1}$  at vigorous int to total at least  $75 m \cdot wk^{-1}$*
  - *At least 20 to 30 min on 3 to 5  $d \cdot wk^{-1}$  of moderate and vigorous intensity*
- To promote/maintain weight loss:
  - *50 to 60  $min \cdot d^{-1}$  daily exercise to total 300 minutes moderate, 150 minutes vigorous or an equivalent combination*
- Intermittent exercise is an effective alternate to continuous exercise.
- Total caloric expenditure or step counts may be used as alternate measures of duration.
- Minimum caloric expenditure of  $1,000 kcal \cdot wk^{-1}$  of physical activity and at least 3,000 to 4,000 steps per day are recommended.



## Mode (Type)

- Exercise should be:
  - rhythmic,
  - aerobic type, and
  - large muscle groups.
- Physiologic adaptations are specific to the type of exercise performed.

**TABLE 7.3. AEROBIC (CARDIOVASCULAR ENDURANCE) EXERCISES TO IMPROVE PHYSICAL FITNESS**

EXERCISE GROUP	EXERCISE DESCRIPTION	RECOMMENDED FOR	EXAMPLES
A	Endurance activities requiring minimal skill or physical fitness to perform	All adults	Walking, leisurely cycling, aqua-aerobics, slow dancing
B	Vigorous-intensity endurance activities requiring minimal skill	Adults with a regular exercise program and/or at least average physical fitness	Jogging, running, rowing, aerobics, spinning, elliptical exercise, stepping exercise, fast dancing

Adapted from American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 7th ed. Philadelphia (PA): Lippincott Williams & Wilkins; 2005. p. 140.

**TABLE 7.3. AEROBIC (CARDIOVASCULAR ENDURANCE) EXERCISES TO IMPROVE PHYSICAL FITNESS**

EXERCISE GROUP	EXERCISE DESCRIPTION	RECOMMENDED FOR	EXAMPLES
C	Endurance activities requiring skill to perform	Adults with acquired skill and/or at least average physical fitness levels	Swimming, cross-country skiing, skating
D	Recreational sports	Adults with a regular exercise program and at least average physical fitness	Racquet sports, basketball, soccer, downhill skiing, hiking

Adapted from American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 7th ed. Philadelphia (PA): Lippincott Williams & Wilkins; 2005. p. 140.

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## Mode (Type): Summary

- Rhythmic, aerobic exercise of at least moderate intensity, involving large muscle groups, and requiring little skill to perform is recommended for all adults to improve health/fitness.
- Other exercise and sports requiring skill to perform or at higher levels of fitness are recommended only for individuals possessing adequate skill and fitness to perform that activity.

**TABLE 7.4. RECOMMENDED FITT FRAMEWORK FOR THE FREQUENCY, INTENSITY AND TIME OF AEROBIC EXERCISE FOR APPARENTLY HEALTHY ADULTS<sup>a</sup>**

HABITUAL PHYSICAL ACTIVITY/ EXERCISE LEVEL	PHYSICAL FITNESS CLASSIFICATION <sup>c</sup>	FREQUENCY		INTENSITY <sup>b</sup>			TIME		
		kcal · wk <sup>-1</sup>	d · wk <sup>-1</sup>	HRR/ $\dot{V}O_2R$	% HR <sub>max</sub>	PERCEPTION OF EFFORT <sup>d</sup>	TOTAL DURATION PER DAY (min)	TOTAL DAILY STEPS DURING EXERCISE <sup>e</sup>	WEEKLY DURATION (min)
Sedentary/no habitual activity/ exercise/extremely deconditioned	Poor	500–1,000	3–5	30%–45%	57%–67%	Light–moderate	20–30	3,000–3,500	60–150
Minimal physical activity/no exercise/moderately–highly deconditioned	Poor–fair	1,000–1,500	3–5	40%–55%	64%–74%	Light–moderate	30–60	3,000–4,000	150–200

**TABLE 7.4. RECOMMENDED FITT FRAMEWORK FOR THE FREQUENCY, INTENSITY AND TIME OF AEROBIC EXERCISE FOR APPARENTLY HEALTHY ADULTS<sup>a</sup>**

HABITUAL PHYSICAL ACTIVITY/ EXERCISE LEVEL	PHYSICAL FITNESS CLASSIFICATION <sup>c</sup>	FREQUENCY		INTENSITY <sup>b</sup>			TIME		
		kcal · wk <sup>-1</sup>	d · wk <sup>-1</sup>	HRR/VO <sub>2</sub> R	% HR <sub>max</sub>	PERCEPTION OF EFFORT <sup>d</sup>	TOTAL DURATION PER DAY (min)	TOTAL DAILY STEPS DURING EXERCISE <sup>e</sup>	WEEKLY DURATION (min)
Sporadic physical activity/no or suboptimal exercise/moderately to mildly deconditioned	Fair-average	1,500–2,000	3–5	55%–70%	74%–84%	Moderate-hard	30–90	≥3,000–4,000	200–300
Habitual physical activity/regular moderate to vigorous intensity exercise	Average-good	>2,000	3–5	65%–80%	80%–91%	Moderate-hard	30–90	≥3,000–4,000	200–300
High amounts of habitual activity/regular vigorous intensity exercise	>Good-excellent	>2,000	3–5	70%–85%	84%–94%	Somewhat hard-hard	30–90	≥3,000–4,000	200–300



# Rate of Progression

- Dependent on individual's health status, exercise tolerance, and exercise program goals
- Any component of FITT may be increased
  - Initially, gradual increase in duration (5–10 minutes) every 1 to 2 weeks over first 4 to 6 weeks is reasonable.
  - After 1 month or more, frequency and intensity may be gradually adjusted until recommended quality and quantity of exercise are met.
- Following adjustments, monitor individual for adverse effects (adjust downward if not well tolerated).



# Muscular Fitness

- Essential component of exercise training program
- May be weight lifting or other devices
- Should improve strength, endurance, and power
- Goals of health-related resistance program
  - Maintain fitness to perform activities of daily living
  - Manage, attenuate, or prevent chronic diseases
- Very important with increasing age

## BOX 7.3

## Resistance-Training Guidelines for Healthy Adults

- Each major muscle group (chest, shoulders, abdomen, back, hips, legs, arms) should be trained with two to four sets. These sets may be of the same exercise or from different exercises affecting the same muscle group.
- The resistance-training program should feature exercises (total of 8–10) that are multijoint or compound exercises that involve more than one muscle group.
- Each major muscle group should be trained  $2\text{--}3 \text{ d} \cdot \text{wk}^{-1}$ . This recommendation may be accomplished either with two to three whole-body sessions of longer duration per week or with a greater number of shorter sessions using a split-body (lower body/upper body) approach, when only selected muscle groups are trained each session. In the split routine, two sessions performed on alternate days are required to train all muscle groups once with a total of four sessions needed to train all muscle groups  $2 \text{ d} \cdot \text{wk}^{-1}$ . Regardless of the approach used, any single muscle group should be rested at least 48 hours between sessions.

## BOX 7.3

# Resistance-Training Guidelines for Healthy Adults

- A resistance that allows 8 to 12 repetitions to be performed each set should be selected. With each set the muscle should feel fatigued but should not be brought to failure. Maximal strength (1-RM) should be periodically assessed for each exercise so that a proper resistance (60%–80% 1-RM) is selected to enable 8 to 12 repetitions per set during training sessions.
- Older individuals should begin a resistance-training program at a lower intensity (e.g., 5–6 on the 10-point rating of perceived exertion scale) that permits 10 to 15 repetitions per set. Once properly conditioned, older individuals may prefer to increase the resistance and perform 8 to 12 repetitions with each set.
- Each exercise should be performed with proper technique and include both lifting (concentric contractions) and lowering (eccentric contractions) phases of the repetition. Each repetition should be completed in a controlled, deliberate fashion throughout the full range of motion.

## BOX 7.3

## Resistance-Training Guidelines for Healthy Adults

- While performing repetitions, maintain a regular breathing pattern that typically involves exhaling during the lifting phase and inhaling during the lowering phase.
- If continued gains in muscular fitness and mass are desired, the individual will have to progressively overload his/her muscles to present a greater training stimulus (i.e., the progressive overload principle). This principle is achieved by using a greater resistance or more weight, performing more repetitions per set but not  $>12$  repetitions, or training muscle groups more frequently.
- In contrast, if the individual is satisfied with the muscular fitness improvements made, a maintenance program may be adopted. During maintenance training, there is no need to progressively overload muscles; rather, the same regimen of sets, repetitions, resistance, and frequency is performed. In fact, assuming the intensity (i.e., resistance) remains the same, muscular fitness may be maintained by training muscle groups only  $1 \text{ d} \cdot \text{wk}^{-1}$ .



## Flexibility Exercise (Stretching)

- Recommended for inclusion in exercise training for all adults
- Improves range of motion and/or counters loss of range of motion with aging
- Scientific evidence regarding stretching and performance, injury prevention, and reduction of muscle soreness not conclusive



## Stretching: Summary

- A stretching exercise program of at least 10 minutes involving the major muscle tendon groups of the body with four or more repetitions per muscle group should be performed a minimum of 2 to 3 d·wk<sup>-1</sup> for most adults.
- Stretches should be performed to the limits of discomfort (mild tightness), but no further.

## BOX 7.4

## Summary of Key Points about Stretching

- Stretching exercise is most effective when the muscles are warm.
- Stretching should be performed before and/or after the conditioning phase.
- Stretching following exercise may be preferable for sports for which muscular strength, power, and endurance are important for performance.
- Stretching may not prevent injury.
- Stretching should be performed at least  $2-3 \text{ d} \cdot \text{wk}^{-1}$ .
- Static, dynamic or ballistic, proprioceptive neuromuscular facilitation (PNF), and dynamic range of motion techniques improve flexibility.

## BOX 7.4 Summary of Key Points about Stretching

- Stretching exercises should involve the major muscle tendon groups of the body.
- $\geq 4$  repetitions per muscle group is recommended.
- Ballistic stretching may be considered particularly for persons whose sports activities involve ballistic movements.
- Static stretches should be held for 15 to 60 seconds.
- A 6-second contraction followed by a 10- to 30-second assisted stretch is recommended for PNF techniques.



# Neuromuscular Exercise

- Recommended particularly for older persons who are at increased risk of falling
- Includes:
  - Balance
  - Proprioceptive training
- Recommended 2 to 3 d·wk<sup>-1</sup>
- Options include Tai Chi, Pilates, and yoga.

**TABLE 7.5. GENERAL GUIDELINES FOR EXERCISE PROGRAM SUPERVISION**

	LEVEL OF SUPERVISION <sup>a</sup>		
	UNSUPERVISED	PROFESSIONALLY SUPERVISED	CLINICALLY SUPERVISED
Health status	Low risk <sup>a</sup>	Moderate risk <sup>b</sup> or high risk <sup>b</sup> with stable disease <sup>c</sup> and regular physical activity habit	High risk <sup>b</sup>
Functional capacity	>7 METs	>7 METs	<7 METs
Low risk	Asymptomatic men and women who have $\leq 1$ risk factor from Table 2.3		
Moderate risk	Asymptomatic men and women who have $\geq 2$ risk factors from Table 2.3		
High risk	Individuals who have one or more signs and symptoms listed in Table 2.2 <i>or</i> known cardiovascular, pulmonary, or metabolic disease		



# Strategies to Enhance Exercise Adherence

- Assessment of self-motivation may be useful.
- Assessment of readiness for exercise (state of change) may be useful.
- Exercise programming and counseling should be client centered.

## BOX 7.5

# Practical Recommendations to Enhance Exercise Adherence

- Obtain healthcare provider support of the exercise program.
- Clarify individual needs to establish the motive for exercise.
- Identify individualized, attainable goals and objectives for exercise.
- Identify safe, convenient, and well-maintained facilities for exercise.
- Identify social support for exercise.
- Identify environmental supports and reminders for exercise.
- Identify motivational exercise outcomes for self-monitoring of exercise progress and achievements, such as exercise logs and step counters.

Adapted from American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 7th ed. Philadelphia (PA): Lippincott Williams & Wilkins; 2005. 167 p.

## BOX 7.5

# Practical Recommendations to Enhance Exercise Adherence

- Emphasize and monitor the acute or immediate effects of exercise (i.e., reduced blood pressure, blood glucose, and need for certain medications).
- Emphasize variety and enjoyment in the exercise program.
- Establish a regular schedule of exercise.
- Provide qualified, personable, and enthusiastic exercise professionals.
- Minimize muscle soreness and injury by participation in exercise of moderate intensity, particularly in the early phase of exercise adoption.

Adapted from American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 7th ed. Philadelphia (PA): Lippincott Williams & Wilkins; 2005. 167 p.